DNA Replication

Big Picture

DNA replication occurs during the S phase (synthesis phase) in the cell cycle for each strand of the double helix parent DNA. As cell divide and replicate, more DNA must be made. Because each complementary strand run in different directions, the process of DNA replication works differently for each strand.

Key Terms

DNA Replication: The process in which a cell's entire DNA is copied.

DNA Helicase: The enzyme that breaks the hydrogen bonds holding the two DNA strands together during DNA replication.

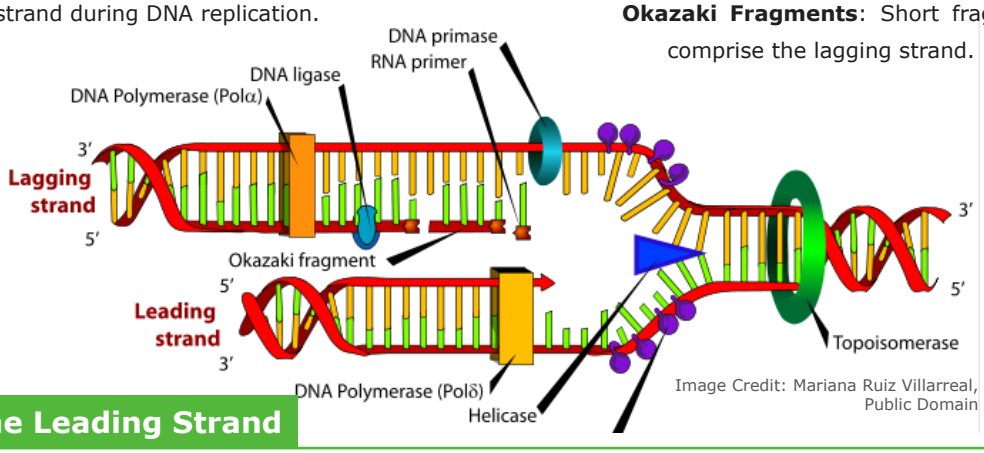
DNA Polymerase: The enzyme that builds a new DNA strand during DNA replication.

Leading Strand: The DNA strand that DNA polymerase constructs in the 5′ → 3′ direction.

Lagging Strand: The DNA strand at the opposite side of the replication fork from the leading strand.

Primase: An enzyme that builds a short RNA primer on the lagging strand during DNA replication.

Okazaki Fragments: Short fragments of DNA that comprise the lagging strand.



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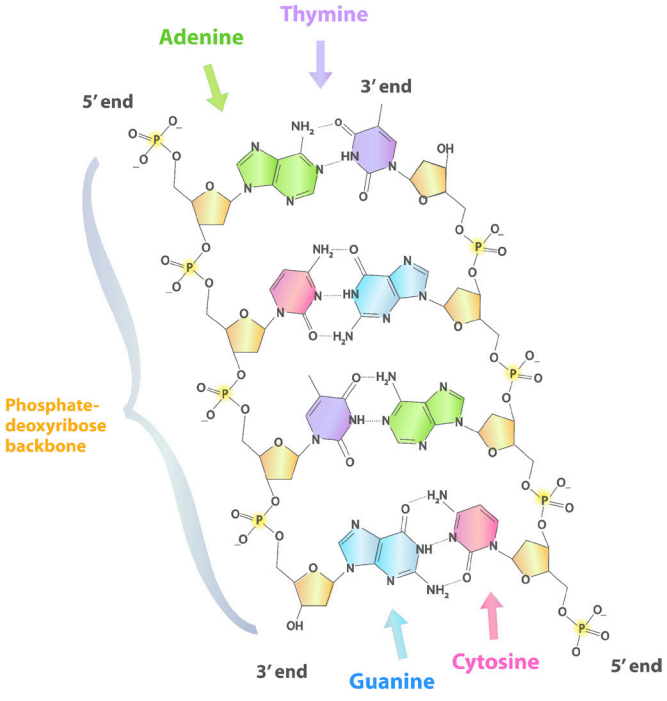
The Leading Strand



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In **DNA replication**, the parent DNA strand must be unwounded by **DNA helicase**, which breaks the hydrogen bonds holding the two separate strands together. Proteins holding the DNA strand keep the strand from winding back together, and an enzyme called topoisomerase relieves the tension that causes the DNA to twist into a helix structure.

DNA polymerase creates the complementary DNA strand to the exposed base pairs of the parent DNA.

Remember that adenine bonds only with thymine, and cytosine only with guanine.

Replication continues until a new DNA has been made, consisting of the new complementary strand and the old strand.

Each DNA stand has a "direction." The 5′ (five prime) end has a terminal phosphate group, and the 3′ (three prime) end has a -OH group.

DNA polymerase only creates the new DNA strand in the 5′ → 3′ direction, so it works differently depending on which strand it is on. On the **leading strand**, which runs from 5′ → 3′, DNA polymerase will work continuously as the replication fork grows.

The Lagging Strand

For the other strand of the original DNA template, called the **lagging strand**, DNA polymerase cannot work continuously in the 3' → 5' direction. So before DNA polymerase creates the complimentary strand, **primase** builds a short RNA primer. DNA polymerase then works on this small region to create DNA in the 5' → 3' direction. As RNA degrades, the new DNA strand takes its place.

The process then repeats until the end of the lagging strand is reached. These synthesized fragments are called **Okazaki fragments.**